DRAFT

6720 SW Macadam Avenue, Suite 125
Portland, Oregon 97219
503.670.1108

ANCHOR QEA

August 10, 2019

Eric Winiecki
United States Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

Re: 2019 Spring Pre-Plant Dairy Application Field Report Memorandum for Cow Palace Dairy, George DeRuyter & Son/D&A Dairies, and Liberty/H&S Bosma Dairies, Yakima Valley Dairies, SDWA-10-2013-0080

This memorandum summarizes the 2019 spring pre-plant sampling activities that were completed at Cow Palace Dairy, George DeRuyter & Son/D&A Dairies, and Liberty/H&S Bosma Dairies (collectively referred to as the Yakima Valley Dairies [Dairies]) by Agrimanagement, Inc., of Yakima, Washington. Sampling activities were consistent with the requirements of the *Dairy Facility Application Field Management Plan* (AFMP; Anchor QEA 2018), submitted to the U.S. Environmental Protection Agency (EPA) in February 2018, and Section III.F.1 of the Statement of Work (SOW; Appendix A of the Administrative Order on Consent [AOC] SDWA-10-2013-0080). Owner certification sheets are provided in Appendix A1 (Cow Palace Dairy), Appendix B1 (George DeRuyter & Son/D&A Dairies), and Appendix C1 (Liberty/H&S Bosma Dairies).

As required under the nutrient management guidelines presented in Section III.F.1 of the AOC SOW, routine soil sampling is required for application fields. Sampling results will be used to monitor mobile and non-mobile nutrients within the upper 2-foot (spring) and 3-foot (fall) portions of the soil column and to determine fertilizer application rates with the goal of maintaining the soil nitrate level below 45 parts per million (ppm) at the 2-foot depth. Soil sampling is performed twice annually and consists of the sampling of spring pre-planting and fall post-harvest conditions.

Soil sampling was conducted by Agrimanagement at the seven application fields associated with Cow Palace Dairy (Figure 1) between May 13 and May 22, 2019; the 14 application fields associated with George DeRuyter & Son/D&A Dairies (Figure 2) between May 2 and May 31, 2019; and the 13 application fields associated with Liberty/H&S Bosma Dairies (Figure 3) between May 14 and June 11, 2019. Liquid and solid manure sampling was conducted at all Dairies on April 24, 2019.

Nitrate concentrations at the 2-foot depth interval were below the 45-ppm goal identified in the AOC SOW in all seven fields sampled for Cow Palace Dairy, in all but two of the 14 fields sampled for George DeRuyter & Son/D&A Dairies, and in all 13 fields sampled for Liberty/H&S Bosma Dairies (Figure 4). Table A2-2 (Cow Palace Dairy), Table B2-2 (George DeRuyter & Son/D&A Dairies), and

Table C2-2 (Liberty/H&S Bosma Dairies) present a summary of the application field soil sampling results at each dairy for the 2019 spring pre-plant sampling event.

Application Field Soil Sample Collection and Analysis

Representative application field soil samples were collected from multiple Sampling Units (SUs) at the Dairies according to protocols described in the AFMP. SUs were determined based criteria detailed in the AFMP, including the following:

- Current Nutrient Management Plan management units
- Field cropping history
- Evaluation of the most recent soil samples collected as part of Nutrient Management Plan requirements
- Soil series and topography
- Irrigation system types and capabilities

Representative samples were collected from a total of seven SUs at Cow Palace Dairy, including CP-SU01, CP-SU02, CP-SU03, CP-SU04A, CP-SU04B, CP-SU05, and CP-SU06 (Figure 1); 14 SUs at George DeRuyter & Son/D&A Dairies, including GDS-SU01 through GDS-SU14 (Figure 2); and 13 SUs at Liberty/H&S Bosma Dairies, including LD-SU02, LD-SU03, LD-SU04, LD-SU05, LD-SU06, LD-SU07, LD-SU08N, LD-SU08S, LD-SU09, LD-SU10, LD-SU14, LD-SU16, and LD-SU17 (Figure 3). Samples were collected within the SU in a random method (zig-zag or meander) to thoroughly represent the SU. Representative samples or field composites were collected from specific intervals at each SU. Subsample intervals were taken at 0 to 12 inches and 12 to 24 inches below ground surface. As stated in the AFMP, the number of subsamples collected is based upon the size of the SU.

Representative samples were collected according to the methods and procedures (i.e., sample volume, preservation, and handling) stated in the AFMP except when hard (i.e., difficult to penetrate) soil was encountered. Section 2.3.1 of the AFMP states, "At any sampling location where soil is difficult to dig through, documentation will be provided to EPA that shows that at least three hand tools designed for digging through hard soils were employed in an effort to reach the required sample depth." Agrimanagement personnel determined that soil samples collected using an alternative method of sample collection suited for hard soils (e.g., shovel, trowel, or pick) yielded a subsample that was more inconsistent in composition and volume than that collected using an open-faced soil sampling tube. Agrimanagement largely employed one method of sample collection—a hydraulic soil probe—within each SU to maintain sample collection consistency. A 4-foot by 1-inch-diameter hand-driven sample probe was used for some SUs because the hydraulic probe was out of service for repairs.

The AFMP requires the collection of one equipment blank per dairy per application field sampling event. As such, equipment blanks (CP-EB-SOIL-19S, GDS-EB-SOIL-19S, and LD-EB-SOIL-19S) were collected.

Application field samples were submitted to SoilTest Farm Consultants, Inc. (SoilTest), of Moses Lake, Washington, for laboratory analysis of the following:

- Ammonium by Western Coordinating Committee (WCC) Method S-3.50
- Nitrate (as nitrogen) by WCC Method S-3.10
- Phosphorus by WCC Method S-4.10 (Olsen P)
- Potassium by WCC Method S-4.50
- pH by WCC Method S-2.20
- Electrical conductivity by WCC Method S-2.30
- Soil organic matter by WCC Method S-9.10

A summary of application field soil sample collections at each dairy is provided in Table A2-1 (Cow Palace Dairy), Table B2-1 (George DeRuyter & Son/D&A Dairies), and Table C2-1 (Liberty/H&S Bosma Dairies). Figures presenting the location of application field samples per SU are provided in Appendix A3 (Cow Palace Dairy), Appendix B3 (George DeRuyter & Son/D&A Dairies), and Appendix C3 (Liberty/H&S Bosma Dairies). Tables of application field sample locations (latitude and longitude) are presented in Appendix A4 (Cow Palace Dairy), Appendix B4 (George DeRuyter & Son/D&A Dairies), and Appendix C4 (Liberty/H&S Bosma Dairies).

Liquid Manure Sample Collection and Analysis

Liquid manure samples were collected at the Dairies on April 24, 2019. At Cow Palace Dairy, two liquid manure samples were collected from Catch Basin No. 2 (CP-CB02-LM-19S) and Lagoon No. 2 (CP-LG02-LM-19S). At George DeRuyter & Son/D&A Dairies, three liquid manure samples were collected from George DeRuyter & Son Dairy Lagoon No. 2 (GDS-LG02-LM-19S) and Lagoon No. 3 (GDS-LG03-LM-19S) and D&A Dairy Lagoon No. 3 (GDS-DA-LG03-LM-19S). At Liberty/H&S Bosma Dairies, three liquid manure samples were collected from H&S Bosma Dairy Lagoon No. 1 (LD-LG01-LM-19S), H&S Bosma Dairy Lagoon No. 6 (LD-LG06-LM-19S), and Liberty Dairy Lagoon No. 14 (LD-LG14-LM-19S). Lagoon samples consisted of a minimum of three subsamples collected from different areas of the lagoon. For each subsample, the scum was removed from the lagoon surface (where applicable), the liquid was agitated, and a sample was taken approximately 12 inches below the surface. Representative samples were collected according to the methods and procedures (i.e., sample volume, preservation, and handling) stated in the AFMP.

The AFMP also requires the collection of an equipment blank, field blank, and duplicate sample per manure sampling day. As such, an equipment blank (EB-MANURE-19S), field blank (FB-MANURE-19S), and duplicate samples (CP-LG02-LM-19S-D from Cow Palace Dairy Lagoon No. 2, GDS-LG03-LM-19S-D from George DeRuyter & Son Dairy Lagoon No. 3, and LD-LG14-LM-19S-D from Liberty Dairy Lagoon No. 14) were also collected. There were no deviations in the AFMP manure sample collection methodologies.

Liquid manure samples were submitted to SoilTest for laboratory analysis of the following:

- Ammonium by WCC Method S-3.50
- Total nitrogen by WCC Method P-2.20
- Phosphorus by WCC Method P-4.20
- Potassium by WCC Method P-4.20
- Percent solids by WCC Method B-1.10
- Nitrate (as nitrogen) by WCC Method S-3.10

The locations of liquid manure samples are provided in Figure 5 (Cow Palace Dairy), Figures 6A and 6B (George DeRuyter & Son/D&A Dairies), and Figures 7A and 7B (Liberty/H&S Bosma Dairies).

Solid Manure Sample Collection and Analysis

Solid manure samples were collected at the Dairies on April 24, 2019. At Cow Palace Dairy, three solid manure samples were collected from the compost area (CP-COMPOST N-SM-19S and CP-COMPOST S-SM-19S) and the solid separator (CP-SEPARATOR-SM-19S). At George DeRuyter & Son/D&A Dairies, two solid manure samples were collected from the north and south portions of the compost area (GDS-COMPOST N-SM-19S and GDS-COMPOST S-SM-19S). At Liberty/H&S Bosma Dairies, three solid manure samples were collected from the north and south portions of the compost area (LD-COMPOST N-SM-19S and LD-COMPOST S-SM-19S) and the solid separator (LD-SEPARATOR-SM-19S). Representative samples were collected according to the methods and procedures (i.e., sample volume, preservation, and handling) stated in the AFMP.

As directed by the AFMP, an equipment blank (EB-MANURE-19S) and field blank (FB-MANURE-19S) were collected during manure sample collection. Additionally, duplicate samples (CP-COMPOST N-SM-19S-D from the north compost area, GDS-COMPOST S-SM-19S-D from the south compost area, and LD-COMPOST S-SM-19S-D from the south portion of the compost area) were collected. There were no deviations from the AFMP manure sample collection methodologies.

Solid manure samples were submitted to SoilTest for laboratory analysis of the following:

- Ammonium by WCC Method S-3.50
- Total nitrogen by WCC Method P-2.20
- Phosphorus by WCC Method P-4.20
- Potassium by WCC Method P-4.20
- Percent solids by WCC Method B-1.10
- Nitrate (as nitrogen) by WCC Method S-3.10

The locations of solid manure samples are provided in Figure 5 (Cow Palace Dairy), Figures 6A and 6B (George DeRuyter & Son/D&A Dairies), and Figures 7A and 7B (Liberty/H&S Bosma Dairies).

Quality Control

Sample Quality Control

The quality control samples associated with application field and liquid manure sampling were prepared and collected according to the protocols specified in the AFMP. Field duplicate samples were collected during application field sampling on each day that sampling occurred to meet the minimum duplicate sampling criteria. No more than 20 samples were collected for submission to the laboratory for analysis each day. One field blank sample was prepared and submitted during liquid manure sampling. Analytical results for quality control samples are included in Appendix A5 (Cow Palace Dairy), Appendix B5 (George DeRuyter & Son/D&A Dairies), and Appendix C5 (Liberty/H&S Bosma Dairies).

Chain-of-Custody

Chain-of-custody (COC) forms identifying each sample contained in the sample cooler were completed and signed by Agrimanagement personnel and accompanied each respective sample cooler. One COC form was retained for the field records; the remaining copies were placed inside the sample cooler. Samples were delivered to SoilTest by Agrimanagement. Copies of all COC forms are provided in Appendix A5 (Cow Palace Dairy), Appendix B5 (George DeRuyter & Son/D&A Dairies), and Appendix C5 (Liberty/H&S Bosma Dairies).

Field Documentation

As stated in the AFMP, dairy sampling activities were documented in field forms. Copies of the field forms are provided in Appendix A5 (Cow Palace Dairy), Appendix B5 (George DeRuyter & Son/D&A Dairies), and Appendix C5 (Liberty/H&S Bosma Dairies).

Decontamination Procedures

Upon completion of sample collection, sampling equipment was decontaminated according to the procedures described in the AFMP. All equipment was cleaned prior to first use and between SUs. Equipment decontamination was performed to prevent cross contamination between samples and to maintain a clean working environment for all personnel.

Site Investigation Results

Fertility Results

A Fertility Report was prepared for each SU based on the application field sampling activities conducted (Appendix A6 [Cow Palace Dairy], Appendix B6 [George DeRuyter & Son/D&A Dairies], and Appendix C6 [Liberty/H&S Bosma Dairies]). A Fertility Report calculation summary for all Dairies is also provided in Table A2-6 (Cow Palace Dairy), Table B2-6 (George DeRuyter & Son/D&A Dairies), and Table C2-6 (Liberty/H&S Bosma Dairies). A summary of the fertility data presents the mobile and

non-mobile nutrient concentrations per sample interval for the respective SU sampled. If a restrictive layer was encountered during application field sampling, the layer is described and the average sampling depth is noted. All Fertility Reports were prepared in accordance with the objectives specified in the AFMP.

Application Field Soil Sampling Results

A summary of the application field soil sampling results at the Dairies for the 2019 spring pre-plant sampling event is provided in Table A2-2 (Cow Palace Dairy), Table B2-2 (George DeRuyter & Son/D&A Dairies), and Table C2-2 (Liberty/H&S Bosma Dairies). The locations of the dairy application fields are shown in Figure 1 (Cow Palace Dairy), Figure 2 (George DeRuyter & Son/D&A Dairies), and Figure 3 (Liberty/H&S Bosma Dairies). Figure 8 (Cow Palace Dairy), Figure 9 (George DeRuyter & Son/D&A Dairies), and Figure 10 (Liberty/H&S Bosma Dairies) show nitrate concentrations in the 2-foot interval at each field. Maps of subsample locations within each field are presented in Appendix A3 (Cow Palace Dairy), Appendix B3 (George DeRuyter & Son/D&A Dairies), and Appendix C3 (Liberty/H&S Bosma Dairies). Graphs showing nitrate concentrations and sum of tested nitrogen since the beginning of sampling in Fall 2013 for each application field are provided in Appendix A7 (Cow Palace Dairy), Appendix B7 (George DeRuyter & Son/D&A Dairies), and Appendix C7 (Liberty/H&S Bosma Dairies).

For the 2019 spring pre-plant sampling event, a total of 32 out of 34 application fields for the combined Dairies exhibited a nitrate concentration below 45 ppm at the 2-foot interval (Figure 4). These fields include all seven fields sampled for Cow Palace Dairy, all but two of the 14 fields sampled for George DeRuyter & Son/D&A Dairies, and all 13 fields sampled for Liberty/H&S Bosma Dairies. GDS-SU06 exceeded a nitrate concentration of 45 ppm at the 2-foot depth interval (52.4 ppm nitrate), which may have been the result of above-average mineralization or past manure application (Figure B7-11). GDS-SU08 also exceeded a nitrate concentration of 45 ppm at the 2-foot depth interval (62.3 ppm nitrate), which was a result of emergency applications in late February and early March (Figure B7-15). GDS-SU08 does continue a gradual downward trend at the 2-foot level and is expected to be below 45 ppm this fall. These fields will continue to be managed with the goal of reducing and maintaining the soil nitrate level to below 45 ppm at the 2-foot depth.

The Laboratory Data Validation Reports, including analytical sample data sheets, are provided in Appendices A8 and A9 (Cow Palace Dairy), Appendices B8 and B9 (George DeRuyter & Son/D&A Dairies), and Appendices C8 and C9 (Liberty/H&S Bosma Dairies).

A summary of sum of tested nitrogen for each dairy is presented in Table A2-5 (Cow Palace Dairy), Table B2-5 (George DeRuyter & Son/D&A Dairies), and Table C2-5 (Liberty/H&S Bosma Dairies). The sum of tested nitrogen is derived by adding nitrate and ammonium concentrations and converting these concentrations to pounds per acre. The conversion factors used to perform the conversion between ppm and pounds per acre, along with the average soil bulk density for each sampling

interval of the SU, are provided in Table A2-3 (Cow Palace Dairy), Table B2-3 (George DeRuyter & Son/D&A Dairies), and Table C2-3 (Liberty/H&S Bosma Dairies). The average soil bulk density was derived by taking the average of soil bulk densities determined during soil field capacity sampling conducted as part of implementation of the *Irrigation Water Management Plan* (ARCADIS 2014). Each SU and depth interval has a unique average soil bulk density and hence a unique ppm-to-pounds per acre conversion factor. Using site-specific values for the ppm-to-pounds per acre conversions eliminates the confusion resulting from using assumed bulk densities and conversion factors that vary depending on region and reason for data collection.

Liquid and Solid Manure Sampling Results

For the 2019 spring pre-plant sampling event, liquid and solid manure sample results for each dairy were within the typical and expected ranges. Full liquid and solid manure sample results for each dairy are included in Table A2-4 (Cow Palace Dairy), Table B2-4 (George DeRuyter & Son/D&A Dairies), and Table C2-4 (Liberty/H&S Bosma Dairies). Laboratory analytical data sheets are provided in Appendix A5 (Cow Palace Dairy), Appendix B5 (George DeRuyter & Son/D&A Dairies), and Appendix C5 (Liberty/H&S Bosma Dairies).

Data Validation

Laboratory analytical reports were reviewed and validated in accordance with the AFMP. Data qualifiers were added to select data during the data validation process. Additional information regarding data qualifiers and the data validation process can be found in each Dairy's Laboratory Data Validation Reports for soils and manure (Appendices A8 and A9 [Cow Palace Dairy], Appendices B8 and B9 [George DeRuyter & Son/D&A Dairies], and Appendices C8 and C9 [Liberty/H&S Bosma Dairies]).

Owner Certification

Owner certification sheets are provided in Appendix A1 (Cow Palace Dairy), Appendix B1 (George DeRuyter & Son/D&A Dairies), and Appendix C1 (Liberty/H&S Bosma Dairies).

References

Anchor QEA (Anchor QEA, LLC), 2018. *Dairy Facility Application Field Management Plan.* Prepared for Yakima Valley Dairies. February 2018.

ARCADIS, 2014. *Irrigation Water Management Plan.* Prepared for Cow Palace, LLC. Yakima, Washington. November 2014.

Recipients

Adam Dolsen, Cow Palace, LLC
Dan DeRuyter, George DeRuyter & Son Dairy, LLC; D&A Dairy, LLC; George & Margaret, LLC
Henry Bosma, Liberty Dairy, LLC; H&S Bosma Dairy
Eric Winiecki, U.S. Environmental Protection Agency, Region 10
Rene Fuentes, U.S. Environmental Protection Agency, Region 10
Jennifer MacDonald, U.S. Environmental Protection Agency, Region 10
Charles M. Tebbutt, P.C., Law Offices of Charles M. Tebbutt, P.C.
Patrick Ryan, Perkins Coie LLP
Brendan Monahan, Stokes Lawrence PS
Lori Terri Gregory, Foster Pepper PLLC
Mark Larsen, Anchor QEA, LLC

Accompanying Materials

Figures

Figure 1	Application Field Locations – Cow Palace Dairy
Figure 2	Application Field Locations – George DeRuyter & Son/D&A Dairies
Figure 3	Application Field Locations – Liberty/H&S Bosma Dairies
Figure 4	Application Fields in Excess of 45 ppm NO3-N
Figure 5	Liquid and Solid Manure Sample Locations – Cow Palace Dairy
Figure 6A	Liquid and Solid Manure Sample Locations – George DeRuyter & Son Dairy
Figure 6B	Liquid and Solid Manure Sample Locations – D&A Dairy
Figure 7A	Liquid and Solid Manure Sample Locations – Liberty Dairy
Figure 7B	Liquid and Solid Manure Sample Locations – H&S Bosma Dairy
Figure 8	Soil Nitrate Concentrations at 2-Foot Depth – Cow Palace Dairy
Figure 9	Soil Nitrate Concentrations at 2-Foot Depth – George DeRuyter & Son/D&A Dairies
Figure 10	Soil Nitrate Concentrations at 2-Foot Depth – Liberty/H&S Bosma Dairies

Appendices

Appendix A Cow Palace Dairy Supporting Documents
- Appendix A1 Owner Certification
- Appendix A2 Tables
- Appendix A3 Sample Location Maps
- Appendix A4 Sample Location Coordinates
- Appendix A5 Field Forms
- Appendix A6 Fertility Reports
- Appendix A7 Nitrate Concentrations and Sum of Tested Nitrogen Graphs
- Appendix A8 Data Validation Report – Soils
- Appendix A9 Data Validation Report – Manure

Appendix B George DeRuyter & Son/D&A Dairies Supporting Documents
- Appendix B1 Owner Certification
- Appendix B2 Tables
- Appendix B3 Sample Location Maps
- Appendix B4 Sample Location Coordinates
- Appendix B5 Field Forms
- Appendix B6 Fertility Reports
- Appendix B7 Nitrate Concentrations and Sum of Tested Nitrogen Graphs
- Appendix B8 Data Validation Report – Soils
- Appendix B9 Data Validation Report – Manure

Appendix C Liberty/H&S Bosma Dairies Supporting Documents
- Appendix C1 Owner Certification
- Appendix C2 Tables
- Appendix C3 Sample Location Maps
- Appendix C4 Sample Location Coordinates
- Appendix C5 Field Forms
- Appendix C6 Fertility Reports
- Appendix C7 Nitrate Concentrations and Sum of Tested Nitrogen Graphs
- Appendix C8 Data Validation Report – Soils
- Appendix C9 Data Validation Report – Manure

Figures

LEGEND:

- Approximate Boundary of Dairy Facilities
- Respondent Ownership Boundary
- Dairy Application Field

0 750
Feet

Publish Date: 2019/07/24, 7:55 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_9996\YakimaDairiesAMaps\PostHarvest_2019\AQ_YVD_Fig01_ApplicationFields_CP_PostHarvest_2019.mxd

ANCHOR QEA

Figure 1
Application Field Locations – Cow Palace Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

Publish Date: 2019/07/24, 7:54 AM | User: alesueur
Filepath: \\corp\gis\Jobs\PerkinsCoie_0996\YakimaDairiesMaps\PostHarvest_2019\AQ_YVD_Fig02_ApplicationFields_GDS_PostHarvest_2019.mxd

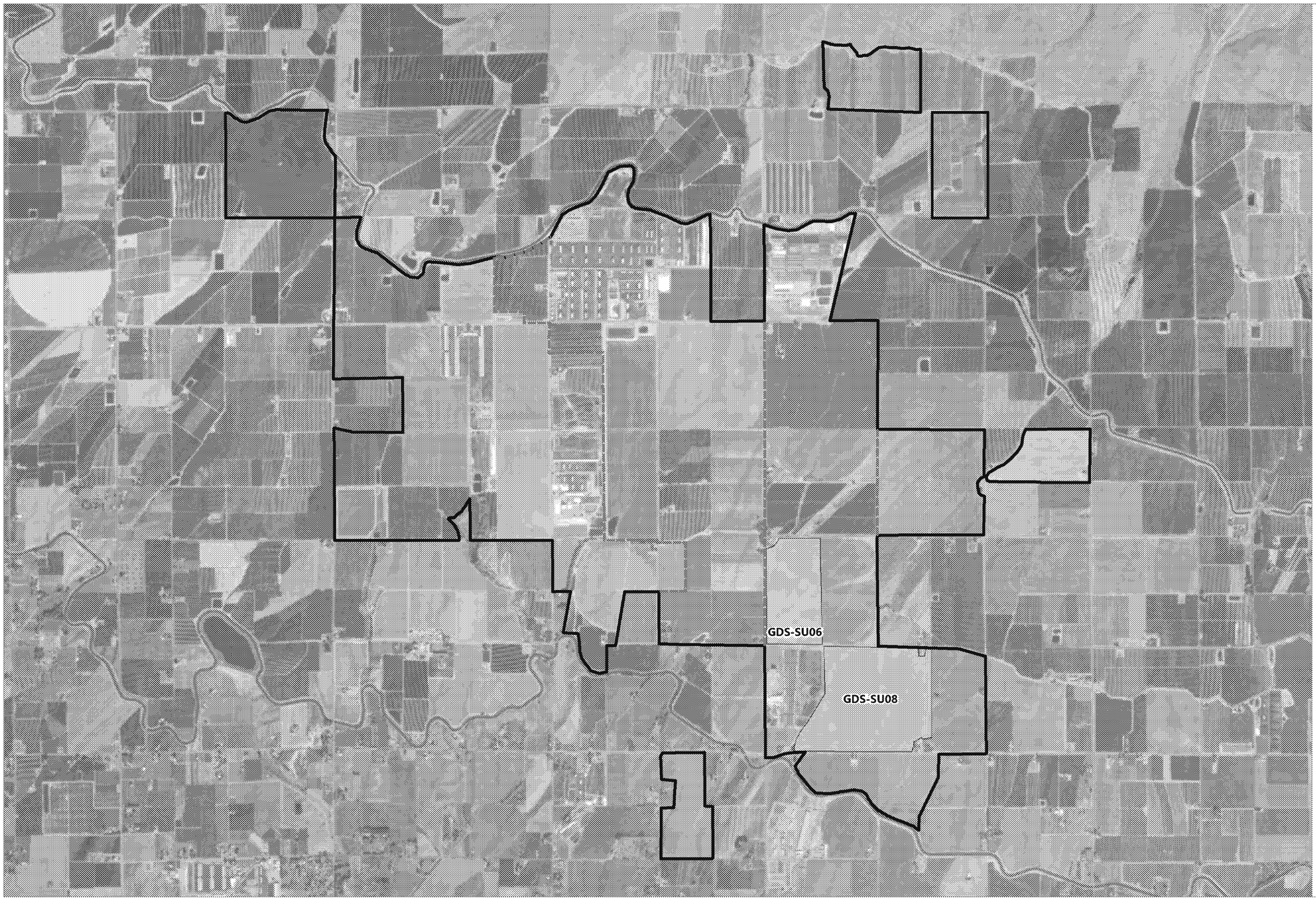
ANCHOR QEA

Figure 2
Application Field Locations – George DeRuyter & Son/D&A Dairies
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

Publish Date: 2019/07/24, 7:57 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\Perkins\Cole_0996\YakimaDairiesMaps\PostHarvest_2019\AQ_YVD_Fig03_ApplicationFields_LB_PostHarvest_2019.mxd

ANCHOR QEA

Figure 3
Application Field Locations – Liberty/H&S Bosma Dairies
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies



LEGEND:

- Approximate Boundary of Dairy Facilities
- Respondent Ownership Boundary
- Application Field in Excess of 45 ppm NO3-N at 2-Foot Level

0 2,500
Feet

Publish Date: 2019/07/26, 7:05 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_0996\YakimaDairies\Maps\PrePlant_2019\AQ_YVD_Fig04_Exceed45ppm_PrePlant_2019.mxd

ANCHOR QEA

Figure 4
Application Fields in Excess of 45 ppm NO3-N
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

Publish Date: 2019/07/24, 8:13 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_0996\YakimaDairies\Maps\PostHarvest_2019\AQ_YVD_Fig05_LiquidSolidSamples_CP_PostHarvest_2019.mxd

ANCHOR QEA

Figure 5
Liquid and Solid Manure Sample Locations – Cow Palace Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

Publish Date: 2019/07/24, 8:15 AM | User: alesueur
Filepath: \\Orcas\gis\Jobs\PerkinsCole_0996\YakimaDairiesAMaps\PostHarvest_2019\AO_YVD_Fig06A_LiquidSolidSamples_GDS_PostHarvest_2019.mxd

ANCHOR QEA

Figure 6A
Liquid and Solid Manure Sample Locations – George DeRuyter & Son Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

Publish Date: 2019/07/24, 8:18 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_9996\YakimaDairiesAMaps\PostHarvest_2019\AQ_YVD_Fig06B_LiquidSolidSamples_DA_PostHarvest_2019.mxd

ANCHOR QEA

Figure 6B
Liquid and Solid Manure Sample Locations – D&A Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

LEGEND:

- Approximate Boundary of Dairy Facilities
- Liquid Manure Sample
- Solid Manure Sample

0 300

Feet

Publish Date: 2019/07/24, 8:23 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_0996\YakimaDairiesAMaps\PostHarvest_2019\AQ_YVD_Fig07A_LiquidSolidSamples_LD_PostHarvest_2019.mxd

ANCHOR QEA

Figure 7A
Liquid and Solid Manure Sample Locations – Liberty Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies

LEGEND:

- Approximate Boundary of Dairy Facilities
- Liquid Manure Sample
- Solid Manure Sample

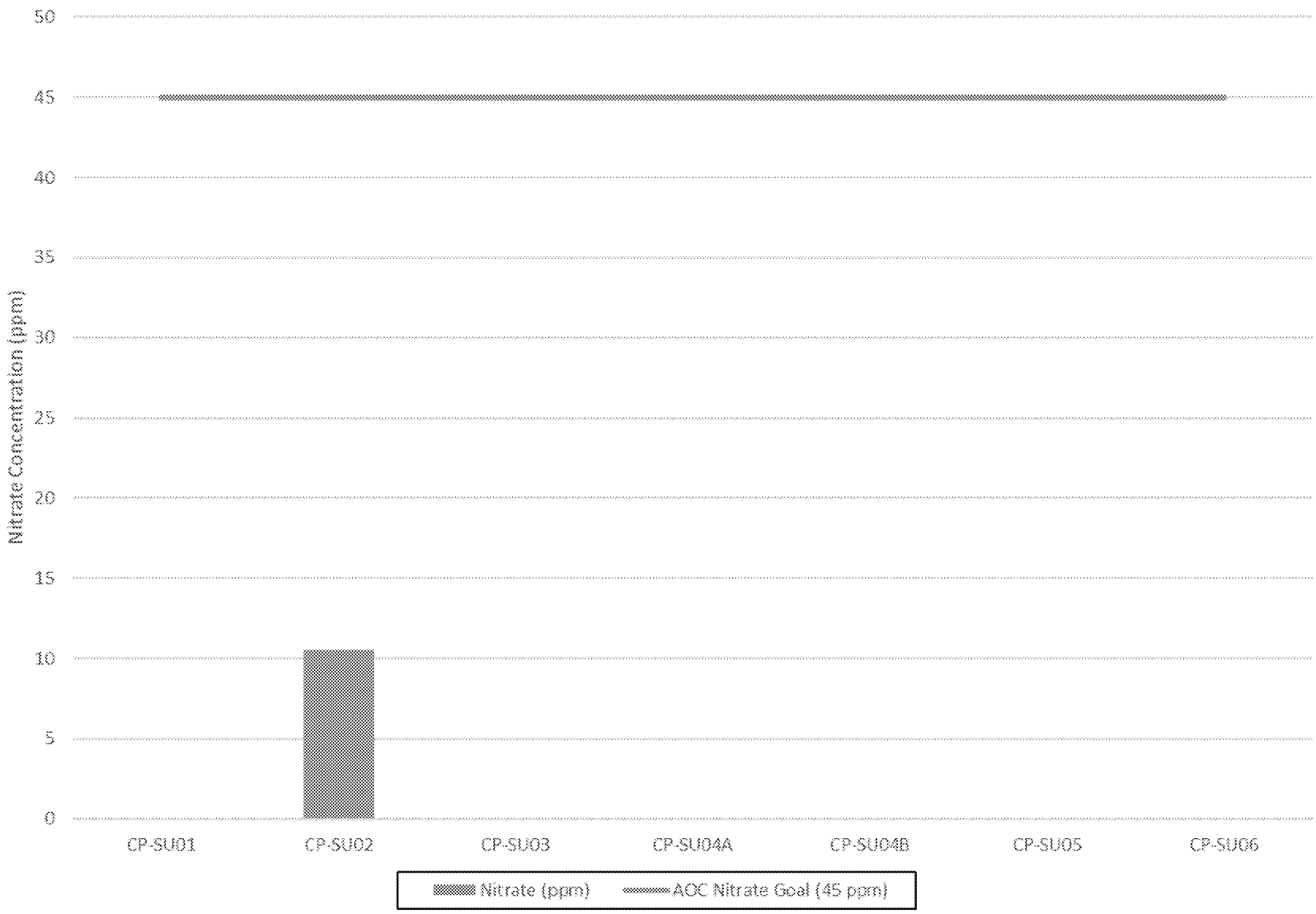
0 250

Feet

Publish Date: 2019/07/24, 8:27 AM | User: alesueur
Filepath: \\orcas\gis\Jobs\PerkinsCole_0996\YakimaDairiesAMaps\PostHarvest_2019\AO_YVD_Fig07B_LiquidSolidSamples_H&S_PostHarvest_2019.mxd

ANCHOR QEA

Figure 7B
Liquid and Solid Manure Sample Locations – H&S Bosma Dairy
2019 Pre-Plant Dairy Application Field Report Memorandum
Yakima Valley Dairies



Filepath: \\fujhanchor\Projects\Yakima Dairies\GDWA AOC\Deliverables\04 - DAFRs\2019a Pre-plant\Draft report submittal 2019-08-10\Figures\Word Docs\Figure 8.docx

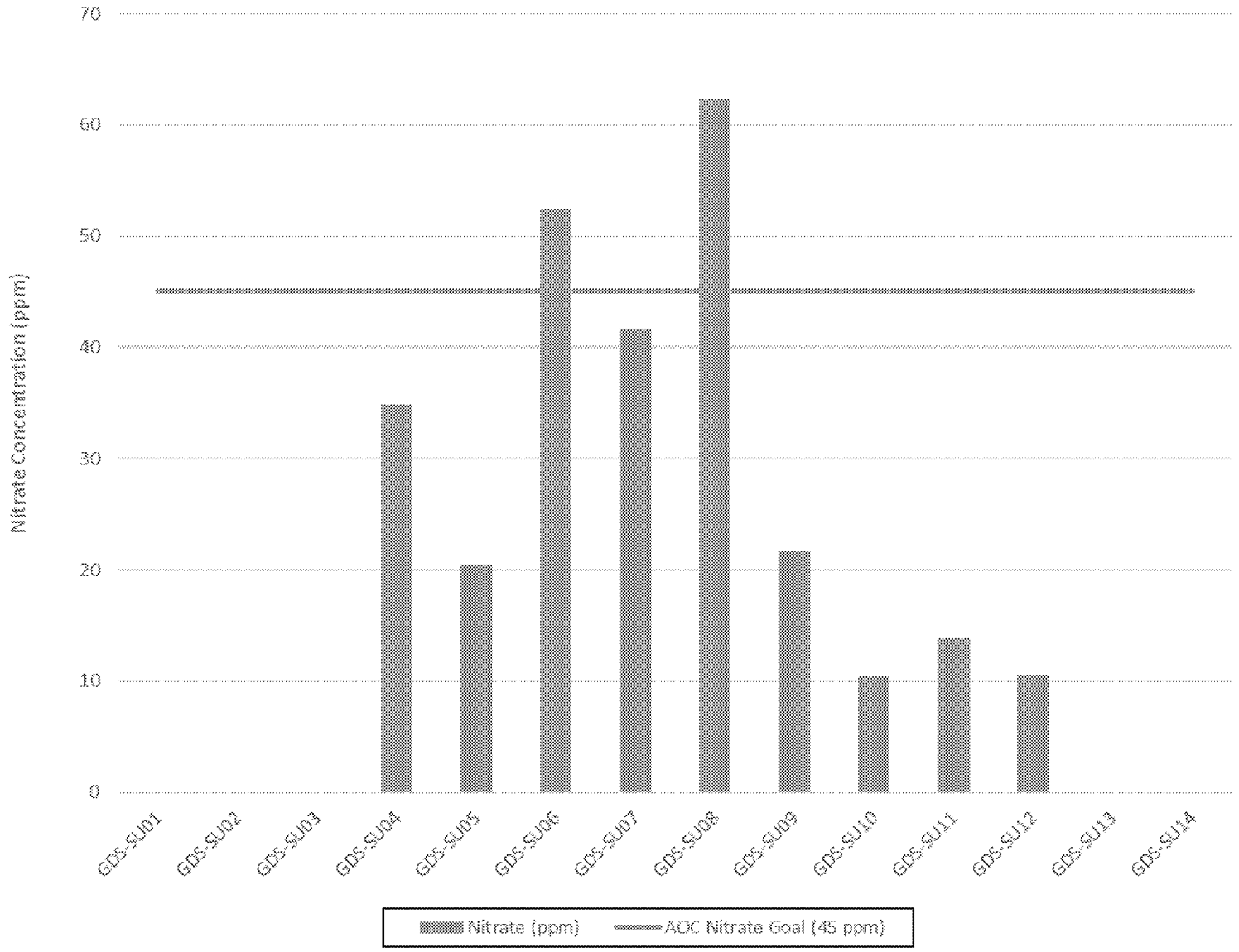
ANCHOR QEA

Figure 8

Soil Nitrate Concentrations at 2-Foot Depth – Cow Palace Dairy

2019 Pre-Plant Dairy Application Field Report Memorandum

Yakima Valley Dairies



Filepath: \\fujhanchor\Projects\Yakima Dairies\GDWA AOC\Deliverables\04 - DAFRs\2019a Pre-plant\Draft report submittal 2019-08-10\Figures\Word Docs\Figure 9.docx

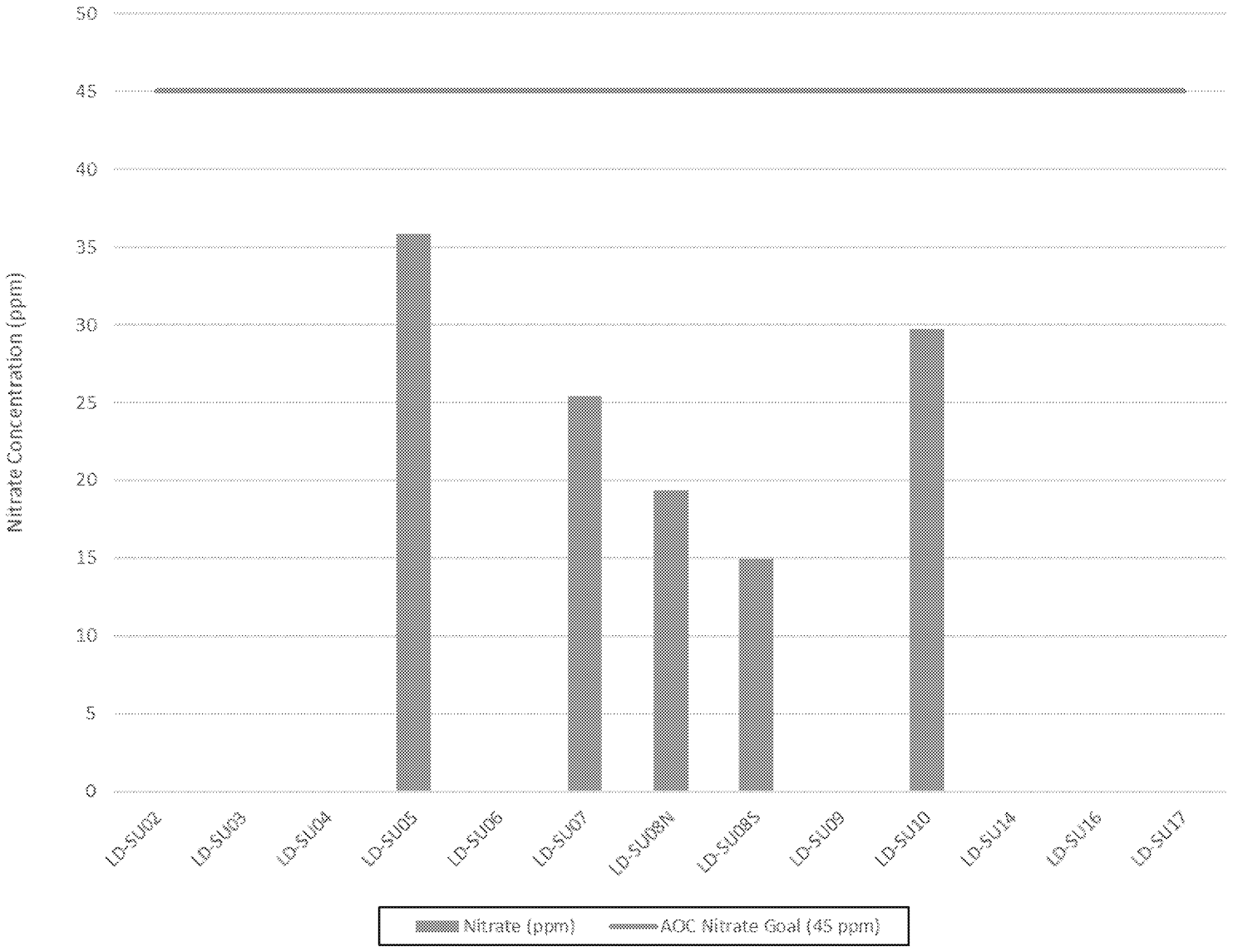
ANCHOR QEA

Figure 9

Soil Nitrate Concentrations at 2-Foot Depth – George DeRuyter & Son/D&A Dairies

2019 Pre-Plant Dairy Application Field Report Memorandum

Yakima Valley Dairies



Filepath: \\fujiAnchor\Projects\Yakima Dairies\SDWA AOC\Deliverables\04 - DAFRs\2019a Pre-plant\Draft report submittal 2019-08-10\Figures\Word Docs\Figure 10.docx

ANCHOR QEA

Figure 10

Soil Nitrate Concentrations at 2-Foot Depth – Liberty/H&S Bosma Dairies

2019 Pre-Plant Dairy Application Field Report Memorandum

Yakima Valley Dairies

Appendix A
Cow Palace Dairy Supporting Documents

Appendix A1
Owner Certification

Certification

I certify under the penalty of law that this document and all attachments were prepared by me or under my direction or supervision in accordance with a system designed to assure that qualified personnel gathered and evaluated the information submitted. Based on my inquiry of any and all persons directly responsible for gathering and analyzing the information obtained, I certify that the information contained in or accompanying this submittal is, to the best of my knowledge and belief, true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Cow Palace, LLC

Signature: Jeffrey M Brown On Behalf of Adam Dolsen

Name: Adam Dolsen

Title: Member

Date: 08/05/19

Appendix A2
Tables

Table A2-1

Application Field Soil Sample Collections – Cow Palace Dairy

Sample Unit	Sample Date	Depth Interval (inches)	No. of Sample Sites	No. of Subsamples Collected	Restrictive Layer Encountered? (Y/N)	Duplicate Sample Collected? (Y/N)	Equipment Used	Notes
CP-SU01	5/20/2019	0 to 12	30	30	Y	N	Hydraulic probe	Rocks encountered[1]
CP-SU01	5/20/2019	12 to 24	30	30	Y	N	Hydraulic probe	Rocks encountered[1]
CP-SU02	5/22/2019	0 to 12	30	30	N	N	Hydraulic probe	None
CP-SU02	5/22/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
CP-SU03	5/20/2019	0 to 12	30	30	N	Y	Hydraulic probe	None
CP-SU03	5/20/2019	12 to 24	30	30	N	N	Hydraulic probe	None
CP-SU04A	5/14/2019	0 to 12	30	30	N	N	Hydraulic probe	None
CP-SU04A	5/14/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
CP-SU04B	5/13/2019	0 to 12	25	25	N	N	Hydraulic probe	None
CP-SU04B	5/13/2019	12 to 24	25	25	N	N	Hydraulic probe	None
CP-SU05	5/22/2019	0 to 12	25	25	N	N	Hydraulic probe	None
CP-SU05	5/22/2019	12 to 24	25	25	N	N	Hydraulic probe	None
CP-SU06	5/13/2019	0 to 12	30	30	N	N	Hydraulic	None
CP-SU06	5/13/2019	12 to 24	30	30	N	Y	Hydraulic	None

Notes:

1. Rocks or compaction were encountered; however, the target number of subsamples consisting of at least 30 grams were collected.

Hydraulic probe: Amity 3-foot direct-push hydraulic sampler

Table A2-2

Application Field Soil Sample Results – Cow Palace Dairy

Sample ID	Sample Date	Sample Type	Depth Interval (inches)	Nitrate (as N) (ppm)	Ammonium (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH (standard units)	Conductivity, Electrical (mmhos/cm)	Organic Matter (%)
CP-SU01-A-19S	5/20/2019	Primary	0 to 12	16.1	2.7	172 J	1,057 J	8	0.49	2.5
CP-SU01-B-19S	5/20/2019	Primary	12 to 24	6.4 U	2.1	94 J	1,168 J	8.6	0.29	1.1
CP-SU02-A-19S	5/22/2019	Primary	0 to 12	27.4	0.9	99 J	1,029 J	8.1	0.46	2.2
CP-SU02-B-19S	5/22/2019	Primary	12 to 24	10.5	1.8	49 J	730 J	8.8	0.33	0.9
CP-SU02-B-19S-D	5/22/2019	Duplicate	12 to 24	9.8	2	46 J	685 J	8.8	0.34	0.7
CP-SU03-A-19S	5/20/2019	Primary	0 to 12	15.6 J	2.1	130 J	757 J	8	0.36	1.6 J
CP-SU03-A-19S-D	5/20/2019	Duplicate	0 to 12	12.4 J	1.9	117 J	673 J	8.2	0.47	2.3 J
CP-SU03-B-19S	5/20/2019	Primary	12 to 24	6.6 U	0.9	38 J	246 J	8.7	0.43	0.7
CP-SU04A-A-19S	5/14/2019	Primary	0 to 12	5.6 U	3.9	95	618	7.9	0.28	2.7
CP-SU04A-B-19S	5/14/2019	Primary	12 to 24	1.5 U	3.6 U	45	375	8.4	0.1	0.9
CP-SU04A-B-19S-D	5/14/2019	Duplicate	12 to 24	1.5 U	3.6 U	48	366	8.4	0.18	0.8
CP-SU04B-A-19S	5/13/2019	Primary	0 to 12	4.1 U	3.6 U	62	620	8.2	0.34	2
CP-SU04B-B-19S	5/13/2019	Primary	12 to 24	1.9 U	3.6 U	39	338	8.5	0.16	0.9
CP-SU05-A-19S	5/22/2019	Primary	0 to 12	11.5	2.3	107 J	1,105 J	8.1	0.36	1.7
CP-SU05-B-19S	5/22/2019	Primary	12 to 24	5.9 U	3.7	55 J	646 J	8.3	0.32	1
CP-SU06-A-19S	5/13/2019	Primary	0 to 12	5.6 U	1.5	66	508	8.1	0.27	2.1
CP-SU06-B-19S	5/13/2019	Primary	12 to 24	5.1 U	3.6 U	32	282	7.8	0.31	1 J
CP-SU06-B-19S-D	5/13/2019	Duplicate	12 to 24	5.1 U	3.6 U	31	291	8.5	0.27	1.5 J
CP-EB-SOIL-19S	5/22/2019	Equipment Blank	QC	1.8	3.6 U	5.6 UJ	48 U	7.5	0.11	0.24 U

Notes:

--: not applicable

J: Estimated value.

mmhos/cm: millimhos per centimeter

N: nitrogen

ppm: parts per million

QC: quality control

U: The result is not detected at the reported value.

UJ: The compound or analyte was analyzed for but not detected, and the specified limit reported is estimated.

Table A2-3

Soil Bulk Density and Conversion Factors – Cow Palace Dairy

Field	Interval (inches)	Average Bulk Density[1] (g/cm^3)	Conversion Factor (ppm to lbs/ac)
CP-SU01	0 to 12	1.35	3.66
	12 to 24	1.42	3.87
	24 to 36	1.39	3.79
CP-SU02	0 to 12	1.23	3.33
	12 to 24	1.30	3.52
	24 to 36	1.38	3.75
CP-SU03	0 to 12	1.41	3.83
	12 to 24	1.46	3.96
	24 to 36	1.42	3.86
CP-SU04A	0 to 12	1.26	3.43
	12 to 24	1.29	3.51
	24 to 36	1.31	3.56
CP-SU04B	0 to 12	1.27	3.44
	12 to 24	1.31	3.55
	24 to 36	1.39	3.77
CP-SU05	0 to 12	1.31	3.56
	12 to 24	1.41	3.84
	24 to 36	1.30	3.54
CP-SU06	0 to 12	1.22	3.31
	12 to 24	1.37	3.73
	24 to 36	1.31	3.57

Notes:

1. Soil bulk density data was collected as part of the implementation of the *Irrigation Water Management Plan* .

g/cm^3: grams per cubic centimeter

lbs/ac: pounds per acre

ppm: parts per million

Table A2-4

Liquid and Solid Manure Sample Results – Cow Palace Dairy

Sample ID	Sample Date	Description	Sample Type	Total Nitrogen (ppm)	Ammonium (as N) (ppm)	Nitrate (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	Percent Solids, Weight (%)
CP-CB02-LM-19S	4/24/2019	Liquid	Primary	717 UJ	222 J	4 UJ	69 J	1303 J	0.8 J
CP-LG02-LM-19S	4/24/2019	Liquid	Primary	932 UJ	450 J	3 UJ	82 J	890 J	0.8 J
CP-LG02-LM-19S-D	4/24/2019	Liquid	Duplicate	902 UJ	448 J	3 UJ	82 J	868 J	0.9 J
CP-COMPOST N-SM-19S	4/24/2019	Solid	Primary	15,700 J	598 J	1,137 J	8,500 J	26,700 J	59.1 J
CP-COMPOST N-SM-19S-D	4/24/2019	Solid	Duplicate	14,600 J	640 J	1,078 J	9,400 J	25,800 J	60.3 J
CP-COMPOST S-SM-19S	4/24/2019	Solid	Primary	16,200 J	675 J	170 J	9,200 J	30,500 J	73.6 J
CP-SEPARATOR-SM-19S	4/24/2019	Solid	Primary	22,300 J	3,478 J	25 J	7,900 J	5,200 J	24.6 J
EB-MANURE-19S	4/24/2019	QC	Equipment Blank	401 J	6 J	1 J	-- R	-- R	-- R
FB-MANURE-19S	4/24/2019	QC	Field Blank	172 J	5 J	1 J	-- R	-- R	-- R

Notes:

--: not applicable

J: Estimated value.

N: nitrogen

ppm: parts per million

QC: quality control

R: Rejected.

U: The result is not detected at the reported value.

UJ: The compound or analyte was analyzed for but not detected, and the specified limit reported is estimated.

Table A2-5

Sum of Tested Nitrogen – Cow Palace Dairy

Sample Unit	Depth Interval (inches)	NO3-N (ppm)	NO3-N (lbs/ac)	NH4 (lbs/ac)	Sum of Tested N (lbs/ac)
CP-SU01	0 to 12	16.1	59.0	9.9	68.9
CP-SU01	12 to 24	ND	ND	8.1	8.1
CP-SU02	0 to 12	27.4	91.3	3.0	94.3
CP-SU02	12 to 24	10.5	37.0	6.3	43.3
CP-SU03	0 to 12	15.6	59.7	8.0	67.7
CP-SU03	12 to 24	ND	ND	3.6	3.6
CP-SU04A	0 to 12	ND	ND	13.4	13.4
CP-SU04A	12 to 24	ND	ND	ND	0.0
CP-SU04B	0 to 12	ND	ND	ND	0.0
CP-SU04B	12 to 24	ND	ND	ND	0.0
CP-SU05	0 to 12	11.5	41.0	8.2	49.2
CP-SU05	12 to 24	ND	ND	14.2	14.2
CP-SU06	0 to 12	ND	ND	5.0	5.0
CP-SU06	12 to 24	ND	ND	ND	0.0

Notes:
lbs/ac: pounds per acre
N: nitrogen
ND: not detected
NH4: ammonium
NO3: nitrate
ppm: parts per million

Table A2-6

Fertility Report Calculation Summary – Cow Palace Dairy

Field	Date	Previous Crop	Planned Crop	Projected Crop N Use	Residual Nitrates (3-foot)	Residual Ammonium (3-foot)	Mineralization (Past Manure)	Mineralization (OM)	N Used to Consume (Released from) Past Crop Residue	N That May Not Be Accessible	Calculated N Need
CP-SU01	5/20/2019	Alfalfa	Alfalfa	351	-85	-18	-10	-50	0	20	208
CP-SU02	5/22/2019	Alfalfa	Alfalfa	351	-127	-13	-10	-44	0	30	187
CP-SU03	5/20/2019	Triticale	Silage Corn	285	-85	-12	-10	-32	0	20	166
CP-SU04 A	5/14/2019	Triticale	Alfalfa	292	-24	-15	-5	-54	20	10	224
CP-SU04 B	5/13/2019	Triticale	Alfalfa	292	-21	-4	-5	-40	20	10	252
CP-SU05	5/22/2019	Alfalfa	Alfalfa	351	-63	-22	-10	-34	0	15	237
CP-SU06	5/13/2019	Alfalfa	Alfalfa	331	-37	-7	-5	-42	0	15	255

Notes:
All units are in pounds per acre.
N: nitrogen
OM: organic matter

Appendix B
George DeRuyter & Son/D&A Dairies
Supporting Documents

Appendix B1
Owner Certification

Certification

D&A Dairy and George DeRuyter & Son Dairy Certification

I certify under the penalty of law that this document and all attachments were prepared by me or under my direction or supervision in accordance with a system designed to assure that qualified personnel gathered and evaluated the information submitted. Based on my inquiry of any and all persons directly responsible for gathering and analyzing the information obtained, I certify that the information contained in or accompanying this submittal is, to the best of my knowledge and belief, true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

D&A Dairy, LLC (also known as D and A Dairy LLC)
George DeRuyter & Son, LLC

Signature: Dan DeRuyter

Name: Dan DeRuyter

Title: Member

Date: 9/5/19

Appendix B2
Tables

Table B2-1

Application Field Soil Sample Collections – George DeRuyter Son/D&A Dairies

Sample Unit	Sample Date	Depth Interval (inches)	No. of Sample Sites	No. of Subsamples Collected	Restrictive Layer Encountered? (Y/N)	Duplicate Sample Collected? (Y/N)	Equipment Used	Notes
GDS-SU01	5/14/2019	0 to 12	20	20	N	Y	Hydraulic probe	None
GDS-SU01	5/14/2019	12 to 24	20	20	Y	N	Hydraulic probe	Rocks encountered[1]
GDS-SU02	5/15/2019	0 to 12	30	30	Y	N	Hydraulic probe	Rocks encountered[1]
GDS-SU02	5/15/2019	12 to 24	30	30	Y	N	Hydraulic probe	Rocks encountered[1]
GDS-SU03	5/21/2019	0 to 12	20	20	N	N	Hydraulic probe	None
GDS-SU03	5/21/2019	12 to 24	20	20	Y	N	Hydraulic probe	Rocks encountered[1]
GDS-SU04	5/2/2019	0 to 12	30	30	N	N	Hydraulic probe/ Hand probe	None
GDS-SU04	5/2/2019	12 to 24	30	30	Y	Y	Hydraulic probe/ Hand probe	Compaction encountered[1]
GDS-SU05	5/21/2019	0 to 12	30	30	N	N	Hydraulic probe	None
GDS-SU05	5/21/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
GDS-SU06	5/23/2019	0 to 12	30	30	N	Y	Hydraulic probe	None
GDS-SU06	5/23/2019	12 to 24	30	30	N	N	Hydraulic probe	None
GDS-SU07	5/23/2019	0 to 12	30	30	N	N	Hydraulic probe	None
GDS-SU07	5/23/2019	12 to 24	30	30	N	N	Hydraulic probe	None
GDS-SU08	5/3/2019	0 to 12	30	30	Y	Y	Hand probe	Compaction encountered[1]
GDS-SU08	5/3/2019	12 to 24	30	30	Y	N	Hand probe	Compaction encountered[1]
GDS-SU09	5/31/2019	0 to 12	25	25	Y	Y	Hand probe	Rocks encountered[1]
GDS-SU09	5/31/2019	12 to 24	25	25	Y	N	Hand probe	Rocks encountered[1]
GDS-SU10	5/21/2019	0 to 12	25	25	N	N	Hydraulic probe	None
GDS-SU10	5/21/2019	12 to 24	25	25	N	N	Hydraulic probe	None
GDS-SU11	5/22/2019	0 to 12	20	20	N	Y	Hydraulic probe	None
GDS-SU11	5/22/2019	12 to 24	20	20	N	N	Hydraulic probe	None
GDS-SU12	5/21/2019	0 to 12	25	25	N	N	Hydraulic probe	None
GDS-SU12	5/21/2019	12 to 24	25	25	N	N	Hydraulic probe	None
GDS-SU13	5/15/2019	0 to 12	25	25	N	N	Hydraulic probe	None

Table B2-1

Application Field Soil Sample Collections – George DeRuyter Son/D&A Dairies

Sample Unit	Sample Date	Depth Interval (inches)	No. of Sample Sites	No. of Subsamples Collected	Restrictive Layer Encountered? (Y/N)	Duplicate Sample Collected? (Y/N)	Equipment Used	Notes
GDS-SU13	5/15/2019	12 to 24	25	25	N	Y	Hydraulic probe	None
GDS-SU14	5/15/2019	0 to 12	30	30	N	N	Hydraulic probe	None
GDS-SU14	5/15/2019	12 to 24	30	30	N	N	Hydraulic probe	None

Notes:

1. Rocks or compaction were encountered; however, the target number of subsamples consisting of at least 30 grams were collected.

Hand probe: 4-foot-by-1-inch-diameter steel hand-driven sample probe

Hydraulic probe: Amity 3-foot direct-push hydraulic sampler

Table B2-2

Application Field Soil Sample Results – George DeRuyter Son/D&A Dairies

Sample ID	Sample Date	Sample Type	Depth Interval (inches)	Nitrate (as N) (ppm)	Ammonium (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH (standard units)	Conductivity, Electrical (mmhos/cm)	Organic Matter (%)
GDS-SU01-A-19S	5/14/2019	Primary	0 to 12	4.6 U	4.6	101	471	7.3	0.3	3.2
GDS-SU01-A-19S-D	5/14/2019	Duplicate	0 to 12	5.6 U	1.4	112	491	7.4	0.29	3.4
GDS-SU01-B-19S	5/14/2019	Primary	12 to 24	1.7 U	3.6 U	52	172	8	0.25	1.9
GDS-SU02-A-19S	5/15/2019	Primary	0 to 12	11	4	100	641 J	7.5	0.38	3
GDS-SU02-B-19S	5/15/2019	Primary	12 to 24	3.6 U	2.7	53	258 J	8.1	0.16	1.1
GDS-SU03-A-19S	5/21/2019	Primary	0 to 12	14.7	4.2	112 J	1154 J	7.5	0.65	2.6
GDS-SU03-B-19S	5/21/2019	Primary	12 to 24	7.4 U	1.2	50 J	620 J	7.7	0.48	0.8
GDS-SU04-A-19S	5/2/2019	Primary	0 to 12	42.6	3.3	321	1803	7.9	0.93	2.4
GDS-SU04-B-19S	5/2/2019	Primary	12 to 24	34.9	2.3	99 J	1723	8.2	1.02	1.2
GDS-SU04-B-19S-D	5/2/2019	Duplicate	12 to 24	32.9	3	73 J	1665	8.2	0.91	1
GDS-SU05-A-19S	5/21/2019	Primary	0 to 12	29.6	1.9	397 J	1752 J	7.8	0.73	2.7
GDS-SU05-B-19S	5/21/2019	Primary	12 to 24	20.5	1.3	123 J	2083 J	8.5	0.79	1
GDS-SU05-B-19S-D	5/21/2019	Duplicate	12 to 24	20.4	1.8	122 J	2066 J	8.4	0.48	0.9
GDS-SU06-A-19S	5/23/2019	Primary	0 to 12	42.5	3.6 U	149	1397 J	8.1	0.73	2.3
GDS-SU06-A-19S-D	5/23/2019	Duplicate	0 to 12	41.9	1.4 J	157	1491 J	8.1	0.84	2.3
GDS-SU06-B-19S	5/23/2019	Primary	12 to 24	**52.4**	1.5 J	48	502 J	8.3	0.82	0.8
GDS-SU07-A-19S	5/23/2019	Primary	0 to 12	31.7	3 J	81	1178 J	8.1	0.82	2.1
GDS-SU07-B-19S	5/23/2019	Primary	12 to 24	41.7	3 J	29	285 J	8.1	0.9	0.9
GDS-SU08-A-19S	5/3/2019	Primary	0 to 12	49.1 J	3.4 J	294	2340	8.3	0.96	2.6
GDS-SU08-A-19S-D	5/3/2019	Duplicate	0 to 12	49.9 J	1.4 J	283	2406	7.9	1	2.7
GDS-SU08-B-19S	5/3/2019	Primary	12 to 24	**62.3 J**	1 J	86	2018	8.3	0.16	1.3
GDS-SU09-A-19S	5/31/2019	Primary	0 to 12	52 J	3.7 J	151	1084 J	7.7	0.78	2.8
GDS-SU09-A-19S-D	5/31/2019	Duplicate	0 to 12	52.8 J	1.3 J	145	1043 J	7.7	0.87	2.7
GDS-SU09-B-19S	5/31/2019	Primary	12 to 24	21.7 J	1.3 J	70	331 J	8.2	0.81	1.2
GDS-SU10-A-19S	5/21/2019	Primary	0 to 12	13.7	1.2	31 J	613 J	8.2	0.36	1.7
GDS-SU10-B-19S	5/21/2019	Primary	12 to 24	10.5	3.6 U	8 J	138 J	8.4	0.3	0.6
GDS-SU11-A-19S	5/22/2019	Primary	0 to 12	16.8	2.4	142 J	871 J	7.7	0.41	2.7
GDS-SU11-A-19S-D	5/22/2019	Duplicate	0 to 12	16.9	3.8	137 J	907 J	7.7	0.36	2.8
GDS-SU11-B-19S	5/22/2019	Primary	12 to 24	13.9	2.9	64 J	535 J	8.1	0.34	1
GDS-SU12-A-19S	5/21/2019	Primary	0 to 12	9.8	4.1	114 J	857 J	8	0.33	2.3
GDS-SU12-B-19S	5/21/2019	Primary	12 to 24	10.6	1.5	45 J	458 J	8.1	0.31	1
GDS-SU13-A-19S	5/21/2019	Primary	0 to 12	10.9	1.4	127	585 J	7.9	0.45	2.4
GDS-SU13-B-19S	5/15/2019	Primary	12 to 24	7.7 U	1.1	47	344 J	8.2	0.34	0.9

Table B2-2

Application Field Soil Sample Results – George DeRuyter Son/D&A Dairies

Sample ID	Sample Date	Sample Type	Depth Interval (inches)	Nitrate (as N) (ppm)	Ammonium (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH (standard units)	Conductivity, Electrical (mmhos/cm)	Organic Matter (%)
GDS-SU13-B-19S-D	5/15/2019	Duplicate	12 to 24	7.6 U	2.3	46	341 J	8.2	0.3	0.9
GDS-SU14-A-19S	5/15/2019	Primary	0 to 12	5 U	1.3	74	486 J	7.9	0.32	1.6
GDS-SU14-B-19S	5/15/2019	Primary	12 to 24	3 U	2.5	29	165 J	8.4	0.33	0.8
GDS-EB-SOIL-19S	5/21/2019	Equipment Blank	QC	1.9	3.6 U	1 J	48 U	7.4	0.1	0.24 U

Notes:

Bold: Values greater than 45 ppm in the 2-foot depth interval.

J: Estimated value.

mmhos/cm: millimhos per centimeter

N: nitrogen

ppm: parts per million

QC: quality control

U: The result is not detected at the reported value.

Table B2-3

Soil Bulk Density and Conversion Factors – George DeRuyter Son/D&A Dairies

Field	Interval (inches)	Average Bulk Density[1] (g/cm^3)	Conversion Factor (ppm to lbs/ac)
GDS-SU01	0 to 12	1.22	3.30
	12 to 24	1.45	3.94
	24 to 36	1.03	2.80
GDS-SU02	0 to 12	1.46	3.96
	12 to 24	1.42	3.86
	24 to 36	1.31	3.56
GDS-SU03	0 to 12	1.38	3.74
	12 to 24	1.46	3.97
	24 to 36	--	--
GDS-SU04	0 to 12	1.33	3.63
	12 to 24	1.37	3.74
	24 to 36	1.45	3.94
GDS-SU05	0 to 12	1.32	3.58
	12 to 24	1.49	4.06
	24 to 36	1.35	3.66
GDS-SU06	0 to 12	1.36	3.69
	12 to 24	1.48	4.03
	24 to 36	1.51	4.11
GDS-SU07	0 to 12	1.37	3.73
	12 to 24	1.27	3.45
	24 to 36	1.29	3.52
GDS-SU08	0 to 12	1.30	3.55
	12 to 24	1.38	3.74
	24 to 36	1.54	4.19
GDS-SU09	0 to 12	1.41	3.84
	12 to 24	1.40	3.79
	24 to 36	1.44	3.93
GDS-SU10	0 to 12	1.29	3.52
	12 to 24	1.31	3.57
	24 to 36	1.34	3.64
GDS-SU11	0 to 12	1.24	3.36
	12 to 24	1.37	3.73
	24 to 36	1.36	3.70
GDS-SU12	0 to 12	1.51	4.11
	12 to 24	1.55	4.20
	24 to 36	1.50	4.08
GDS-SU13	0 to 12	1.24	3.36
	12 to 24	1.33	3.61
	24 to 36	1.25	3.40
GDS-SU14	0 to 12	1.28	3.48
	12 to 24	1.41	3.83
	24 to 36	1.36	3.71

Notes:

1. Soil bulk density data was collected as part of the implementation of the *Irrigation Water Management Plan*.

--: not applicable

g/cm^3: grams per cubic centimeter

lbs/ac: pounds per acre

ppm: parts per million

Table B2-4

Liquid and Solid Manure Sample Results – George DeRuyter Son/D&A Dairies

Sample ID	Sample Date	Description	Sample Type	Total Nitrogen (ppm)	Ammonium (as N) (ppm)	Nitrate (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	Percent Solids, Weight (%)
GDS-DA-LG03-LM-19S	4/24/2019	Liquid	Primary	256 UJ	33 J	4 UJ	7 J	111 J	0.4 J
GDS-LG02-LM-19S	4/24/2019	Liquid	Primary	2,778 J	1,175 J	3 UJ	573 J	2,314 J	4.5 J
GDS-LG03-LM-19S	4/24/2019	Liquid	Primary	3,106 J	1,109 J	7 J	786 J	2,642 J	6.1 J
GDS-LG03-LM-19S-D	4/24/2019	Liquid	Duplicate	3,316 J	1,128 J	5 UJ	771 J	2,578 J	6.6 J
GDS-COMPOST N-SM-19S	4/24/2019	Solid	Primary	15,100 J	589 J	225 J	6,700 J	20,100 J	81 J
GDS-COMPOST S-SM-19S	4/24/2019	Solid	Primary	14,700 J	327 J	886 J	6,500 J	14,600 J	72.1 J
GDS-COMPOST S-SM-19S-D	4/24/2019	Solid	Duplicate	15,000 J	358 J	665 J	7,400 J	15,100 J	65.7 J
EB-MANURE-19S	4/24/2019	QC	Equipment Blank	401 J	6 J	1 J	-- R	-- R	-- R
FB-MANURE-19S	4/24/2019	QC	Field Blank	172 J	5 J	1 J	-- R	-- R	-- R

Notes:

--: not applicable

J: Estimated value.

N: nitrogen

ppm: parts per million

QC: quality control

R: Rejected.

U: The result is not detected at the reported value.

UJ: The compound or analyte was analyzed for but not detected, and the specified limit reported is estimated.

Table B2-5

Sum of Tested Nitrogen – George DeRuyter Son/D&A Dairies

Sample Unit	Depth Interval (inches)	NO3-N (ppm)	NO3-N (lbs/ac)	NH4 (lbs/ac)	Sum of Tested N (lbs/ac)
GDS-SU01-A-19S	0 to 12	ND	ND	15.2	15.2
GDS-SU01-B-19S	12 to 24	ND	ND	ND	0.0
GDS-SU02-A-19S	0 to 12	11	43.5	15.8	59.4
GDS-SU02-B-19S	12 to 24	ND	ND	10.4	10.4
GDS-SU03-A-19S	0 to 12	14.7	55.0	15.7	70.7
GDS-SU03-B-19S	12 to 24	ND	ND	4.8	4.8
GDS-SU04-A-19S	0 to 12	42.6	154.5	12.0	166.5
GDS-SU04-B-19S	12 to 24	34.9	130.4	8.6	139.0
GDS-SU05-A-19S	0 to 12	29.6	106.0	6.8	112.8
GDS-SU05-B-19S	12 to 24	20.5	83.3	5.3	88.5
GDS-SU06-A-19S	0 to 12	42.5	156.6	ND	156.6
GDS-SU06-B-19S	12 to 24	52.4	210.9	6.0	217.0
GDS-SU07-A-19S	0 to 12	31.7	118.1	11.2	129.3
GDS-SU07-B-19S	12 to 24	41.7	143.7	10.3	154.0
GDS-SU08-A-19S	0 to 12	49.1	174.1	12.1	186.1
GDS-SU08-B-19S	12 to 24	62.3	233.3	3.7	237.0
GDS-SU09-A-19S	0 to 12	52.0	199.9	14.2	214.1
GDS-SU09-B-19S	12 to 24	21.7	82.3	4.9	87.3
GDS-SU10-A-19S	0 to 12	13.7	48.2	4.2	52.4
GDS-SU10-B-19S	12 to 24	10.5	37.5	ND	37.5
GDS-SU11-A-19S	0 to 12	16.8	56.4	8.1	64.5
GDS-SU11-B-19S	12 to 24	13.9	51.8	10.8	62.6
GDS-SU12-A-19S	0 to 12	9.8	40.3	16.8	57.1
GDS-SU12-B-19S	12 to 24	10.6	44.5	6.3	50.8
GDS-SU13-A-19S	0 to 12	10.9	36.7	4.7	41.4
GDS-SU13-B-19S	12 to 24	ND	ND	4.0	4.0
GDS-SU14-A-19S	0 to 12	ND	ND	4.5	4.5
GDS-SU14-B-19S	12 to 24	ND	ND	9.6	9.6

Notes:
lbs/ac: pounds per acre
N: nitrogen
ND: not detected
NH4: ammonium
NO3: nitrate
ppm: parts per million

Table B2-6

Fertility Report Calculation Summary – George DeRuyter Son/D&A Dairies

Field	Date	Previous Crop	Planned Crop	Projected Crop N Use	Residual Nitrates	Residual Ammonium (3-foot)	Mineralization (Past Manure)	Mineralization (OM)	N Used to Consume (Released from) Past Crop Residue	N That May Not Be Accessible	Calculated N Need
GDS-SU01	5/14/2019	Triticale	Forage Mix	200	-22	-17	-5	-64	20	10	122
GDS-SU02	5/15/2019	Alfalfa	Alfalfa	200	-58	-27	-5	-60	20	15	85
GDS-SU03	5/21/2019	Alfalfa	Alfalfa	325	-86	-21	-10	-52	0	15	171
GDS-SU04	5/2/2019	Alfalfa	Alfalfa	359	-282	-21	-10	-48	0	60	58
GDS-SU05	5/21/2019	Alfalfa	Alfalfa	292	-191	-12	-10	-54	0	50	75
GDS-SU06	5/23/2019	Alfalfa	Alfalfa	260	-367	-8	-15	-46	0	80	0
GDS-SU07	5/23/2019	Alfalfa	Alfalfa	260	-263	-22	-15	-42	0	75	0
GDS-SU08	5/3/2019	Alfalfa	Alfalfa	331	-347	-17	-10	-52	0	85	0
GDS-SU09	5/31/2019	Forage Mix	Alfalfa	200	-280	-19	-15	-56	0	60	0
GDS-SU10	5/21/2019	Alfalfa	Alfalfa	292	-86	-6	-5	-34	0	15	176
GDS-SU11	5/22/2019	Alfalfa	Alfalfa	357	-108	-19	-10	-54	0	20	186
GDS-SU12	5/21/2019	Alfalfa	Alfalfa	357	-85	-23	-10	-46	0	20	213
GDS-SU13	5/15/2019	Triticale	Forage Mix	200	-65	-9	-5	-48	20	15	108
GDS-SU14	5/15/2019	Triticale	Forage Mix	200	-29	-15	-5	-32	20	10	149

Notes:

All units are in pounds per acre.

N: nitrogen

OM: organic matter

Appendix C
Liberty/H&S Bosma Dairies Supporting Documents

Appendix C1
Owner Certification

Certification

I certify under the penalty of law that this document and all attachments were prepared by me or under my direction or supervision in accordance with a system designed to assure that qualified personnel gathered and evaluated the information submitted. Based on my inquiry of any and all persons directly responsible for gathering and analyzing the information obtained, I certify that the information contained in or accompanying this submittal is, to the best of my knowledge and belief, true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Liberty Dairy, LLC, and its associated dairy facility H&S Bosma Dairy

Signature: 

Name: Henry Bosma

Title: Member

Date: 8-1-19

Appendix C2
Tables

Table C2-1

Application Field Soil Sample Collections – Liberty/H&S Bosma Dairies

Sample Unit	Sample Date	Depth Interval (inches)	No. of Sample Sites	No. of Subsamples Collected	Restrictive Layer Encountered? (Y/N)	Duplicate Sample Collected? (Y/N)	Equipment Used	Notes
LD-SU02	6/11/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU02	6/11/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
LD-SU03	5/14/2019	0 to 12	20	20	N	N	Hydraulic probe	None
LD-SU03	5/14/2019	12 to 24	20	20	N	N	Hydraulic probe	None
LD-SU04	5/17/2019	0 to 12	20	20	N	N	Hydraulic probe	None
LD-SU04	5/17/2019	12 to 24	20	20	N	N	Hydraulic probe	None
LD-SU05	6/7/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU05	6/7/2019	12 to 24	30	30	N	N	Hydraulic probe	None
LD-SU06	5/16/2019	0 to 12	25	25	N	N	Hydraulic probe	None
LD-SU06	5/16/2019	12 to 24	25	25	N	N	Hydraulic probe	None
LD-SU07	5/16/109	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU07	5/16/109	12 to 24	30	30	N	Y	Hydraulic probe	None
LD-SU08N	5/17/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU08N	5/17/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
LD-SU08S	6/7/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU08S	6/7/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
LD-SU09	5/17/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU09	5/17/2019	12 to 24	30	30	N	N	Hydraulic probe	None
LD-SU10	5/23/2019	0 to 12	30	30	N	N	Hydraulic probe	None
LD-SU10	5/23/2019	12 to 24	30	30	N	Y	Hydraulic probe	None
LD-SU14	5/17/2019	0 to 12	25	25	N	N	Hydraulic probe	None
LD-SU14	5/17/2019	12 to 24	25	25	N	N	Hydraulic probe	None
LD-SU16	5/14/2019	0 to 12	20	20	N	N	Hydraulic probe	None
LD-SU16	5/14/2019	12 to 24	20	20	N	Y	Hydraulic probe	None
LD-SU17	5/20/2019	0 to 12	25	25	N	N	Hydraulic probe	None
LD-SU17	5/20/2019	12 to 24	25	25	N	Y	Hydraulic probe	None

Note:

Hydraulic probe: Amity 3-foot direct-push hydraulic sampler

Table C2-2

Application Field Soil Sample Results – Liberty/H&S Bosma Dairies

Sample ID	Sample Date	Sample Type	Depth Interval (inches)	Nitrate (as N) (ppm)	Ammonium (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH (standard units)	Conductivity, Electrical (mmhos/cm)	Organic Matter (%)
LD-SU02-A-19S	6/11/2019	Primary	0 to 12	4.6 U	1.3 J	559	2,028 J	8.6	0.32	2.8
LD-SU02-B-19S	6/11/2019	Primary	12 to 24	9.5 U	1.5 J	169	2,976 J	9.1	0.41	0.9
LD-SU02-B-19S-D	6/11/2019	Duplicate	12 to 24	10 U	2.5 J	148	2,750 J	9.2	0.4	1
LD-SU03-A-19S	5/14/2019	Primary	0 to 12	9.4 U	3.6 U	216	1,256	7.5	0.34	2.5
LD-SU03-B-19S	5/14/2019	Primary	12 to 24	3.3 U	3.6 U	60	1,334	8.6	0.27	0.8
LD-SU04-A-19S	5/17/2019	Primary	0 to 12	14 J	3.6 J	193	1,553 J	8.4	0.39	2.2
LD-SU04-B-19S	5/17/2019	Primary	12 to 24	8.1 UJ	3.2 J	169	2,106 J	8.9	0.49	1.6
LD-SU05-A-19S	6/7/2019	Primary	0 to 12	14.9 J	1.4 J	172	1,152 J	8.2	0.41	2.5
LD-SU05-B-19S	6/7/2019	Primary	12 to 24	35.8 J	3.6 UJ	57	225 J	8.6	0.63	1
LD-SU06-A-19S	5/16/2019	Primary	0 to 12	8.4 U	3.1	133	785 J	8.2	0.54	1.8
LD-SU06-B-19S	5/16/2019	Primary	12 to 24	10 U	3.6 U	68	272 J	8.4	1.26	1.1
LD-SU07-A-19S	5/16/2019	Primary	0 to 12	8.3 U	2.4	169	915 J	8	0.66	1.7
LD-SU07-B-19S	5/16/2019	Primary	12 to 24	25.4	3.6 U	81	653 J	8.5	0.99	1
LD-SU07-B-19S-D	5/16/2019	Duplicate	12 to 24	26.4	2.3	68	671 J	8.6	0.87	0.9
LD-SU08N-A-19S	5/17/2019	Primary	0 to 12	20.4 J	3.6 UJ	419	1,806 J	8.2	0.46	3
LD-SU08N-B-19S	5/17/2019	Primary	12 to 24	19.4 J	3.6 UJ	135	1,519 J	8.7	0.62	1.1
LD-SU08N-B-19S-D	5/17/2019	Duplicate	12 to 24	19.8 J	3.6 UJ	132	1,533 J	8.6	0.72	1.1
LD-SU08S-A-19S	6/7/2019	Primary	0 to 12	8.4 UJ	1.1 J	124	1,413 J	8.5	0.41	2.1
LD-SU08S-B-19S	6/7/2019	Primary	12 to 24	14.9 J	3.6 UJ	31	452 J	8.7	0.44	0.8
LD-SU08S-B-19S-D	6/7/2019	Duplicate	12 to 24	16.2 J	0.9 J	38	425 J	8.5	0.39	0.7
LD-SU09-A-19S	5/17/2019	Primary	0 to 12	5.4 UJ	2.1 J	62	243 J	7.5	0.31	1.9
LD-SU09-B-19S	5/17/2019	Primary	12 to 24	3.3 UJ	2.1 J	30	85 J	8.2	0.26	0.7
LD-SU10-A-19S	5/23/2019	Primary	0 to 12	15.4	1.5 J	205	418 J	8.2	0.71	2.9
LD-SU10-B-19S	5/23/2019	Primary	12 to 24	29.7	3.6 U	79	140 J	8.2	0.93	1.1
LD-SU10-B-19S-D	5/23/2019	Duplicate	12 to 24	30.8	3.6 U	81	156 J	8.1	0.97	1.1
LD-SU14-A-19S	5/17/2019	Primary	0 to 12	7.7 UJ	2.7 J	79	613 J	8.4	0.45	2.1
LD-SU14-B-19S	5/17/2019	Primary	12 to 24	10.1 UJ	1.3 J	33	171 J	8.5	0.61	0.7
LD-SU16-A-19S	5/14/2019	Primary	0 to 12	9.5 U	2.2	131	685	7.8	0.33	2.6
LD-SU16-B-19S	5/14/2019	Primary	12 to 24	2.9 U	3.6 U	43	571	8.2	0.22	0.9

Table C2-2

Application Field Soil Sample Results – Liberty/H&S Bosma Dairies

Sample ID	Sample Date	Sample Type	Depth Interval (inches)	Nitrate (as N) (ppm)	Ammonium (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	pH (standard units)	Conductivity, Electrical (mmhos/cm)	Organic Matter (%)
LD-SU16-B-19S-D	5/14/2019	Duplicate	12 to 24	2.8 U	1.4	47	582	8	0.25	1
LD-SU17-A-19S	5/20/2019	Primary	0 to 12	3.8 U	1.1	67 J	560 J	8.4	0.3	1.8
LD-SU17-B-19S	5/20/2019	Primary	12 to 24	1.6 U	3.6 U	19 J	157 J	8.6	0.24	0.7
LD-SU17-B-19S-D	5/20/2019	Duplicate	12 to 24	1.6 U	1.2	18 J	153 J	8.2	0.3	0.7
LD-EB-SOIL-19S	5/17/2019	Equipment Blank	QC	2.3 UJ	3.6 UJ	3	48 U	7.5	0.14	0.24 U

Notes:

Bold: Values greater than 45 ppm in the 2-foot depth interval.

J: Estimated value.

mmhos/cm: millimhos per centimeter

N: nitrogen

ppm: parts per million

QC: quality control

U: The result is not detected at the reported value.

UJ: The compound or analyte was analyzed for but not detected, and the specified limit reported is estimated.

Table C2-3

Soil Bulk Density and Conversion Factors – Liberty/H&S Bosma Dairies

Field	Interval (inches)	Average Bulk Density[1] (g/cm^3)	Conversion Factor (ppm to lbs/ac)
LD-SU02	0 to 12	1.32	3.60
	12 to 24	1.36	3.69
	24 to 36	1.37	3.72
LD-SU03	0 to 12	1.39	3.77
	12 to 24	1.38	3.74
	24 to 36	1.40	3.81
LD-SU04	0 to 12	1.31	3.56
	12 to 24	1.35	3.67
	24 to 36	1.36	3.69
LD-SU05	0 to 12	1.45	3.93
	12 to 24	1.47	4.00
	24 to 36	1.45	3.94
LD-SU06	0 to 12	1.33	3.60
	12 to 24	1.46	3.97
	24 to 36	1.42	3.85
LD-SU07	0 to 12	1.38	3.74
	12 to 24	1.42	3.86
	24 to 36	1.45	3.94
LD-SU08N	0 to 12	1.18	3.22
	12 to 24	1.35	3.68
	24 to 36	1.44	3.91
LD-SU08S	0 to 12	1.48	4.03
	12 to 24	1.47	3.98
	24 to 36	1.52	4.12
LD-SU09	0 to 12	1.38	3.75
	12 to 24	1.42	3.86
	24 to 36	1.50	4.08
LD-SU10	0 to 12	1.53	4.15
	12 to 24	1.53	4.17
	24 to 36	1.34	3.64
LD-SU14	0 to 12	1.48	4.03
	12 to 24	1.52	4.13
	24 to 36	1.51	4.09
LD-SU16	0 to 12	1.45	3.94
	12 to 24	1.46	3.96
	24 to 36	1.40	3.81
LD-SU17	0 to 12	1.41	3.84
	12 to 24	1.49	4.04
	24 to 36	1.50	4.08

Notes:

1. Soil bulk density data was collected as part of the implementation of the *Irrigation Water Management Plan* .

g/cm^3: grams per cubic centimeter

lbs/ac: pounds per acre

ppm: parts per million

Table C2-4

Liquid and Solid Manure Sample Results – Liberty/H&S Bosma Dairies

Sample ID	Sample Date	Description	Sample Type	Total Nitrogen (ppm)	Ammonium (as N) (ppm)	Nitrate (as N) (ppm)	Phosphorus (ppm)	Potassium (ppm)	Percent Solids, Weight (%)
LD-LG01-LM-19S	4/24/2019	Liquid	Primary	1,881 UJ	738 J	5 UJ	176 J	2,463 J	2.2 J
LD-LG06-LM-19S	4/24/2019	Liquid	Primary	1,585 UJ	672 J	3 UJ	107 J	2,255 J	1.9 J
LD-LG14-LM-19S	4/24/2019	Liquid	Primary	3,089 J	1,471 J	5 UJ	566 J	2,708 J	4.4 J
LD-LG14-LM-19S-D	4/24/2019	Liquid	Duplicate	3,183 J	1,463 J	5 UJ	554 J	2,760 J	4.3 J
LD-COMPOST N-SM-19S	4/24/2019	Solid	Primary	13,500 J	34 J	935 J	6,900 J	19,700 J	60 J
LD-COMPOST S-SM-19S	4/24/2019	Solid	Primary	16,600 J	17 UJ	1,217 J	7,000 J	23,000 J	63.9 J
LD-COMPOST S-SM-19S-D	4/24/2019	Solid	Duplicate	16,300 J	20 UJ	1,227 J	10,300 J	23,000 J	65 J
LD-SEPARATOR-SM-19S	4/24/2019	Solid	Primary	17,500 J	2,480 J	25 J	5,000 J	12,500 J	28.4 J
EB-MANURE-19S	4/24/2019	QC	Equipment Blank	401 J	6 J	1 J	-- R	-- R	-- R
FB-MANURE-19S	4/24/2019	QC	Field Blank	172 J	5 J	1 J	-- R	-- R	-- R

Notes:

--: not applicable

J: Estimated value.

N: nitrogen

ppm: parts per million

QC: quality control

R: Rejected.

U: The result is not detected at the reported value.

UJ: The compound or analyte was analyzed for but not detected, and the specified limit reported is estimated.

Table C2-5

Sum of Tested Nitrogen – Liberty/H&S Bosma Dairies

Sample Unit	Depth Interval (inches)	NO3-N (ppm)	NO3-N (lbs/ac)	NH4 (lbs/ac)	Sum of Tested N (lbs/ac)
LD-SU02	0 to 12	ND	ND	4.7	4.7
LD-SU02	12 to 24	ND	ND	5.5	5.5
LD-SU03	0 to 12	ND	ND	ND	0.0
LD-SU03	12 to 24	ND	ND	ND	0.0
LD-SU04	0 to 12	14.0	49.9	12.8	62.7
LD-SU04	12 to 24	ND	ND	11.8	11.8
LD-SU05	0 to 12	14.9	58.6	5.5	64.1
LD-SU05	12 to 24	35.8	143.1	ND	143.1
LD-SU06	0 to 12	ND	ND	11.2	11.2
LD-SU06	12 to 24	ND	ND	ND	0.0
LD-SU07	0 to 12	ND	ND	9.0	9.0
LD-SU07	12 to 24	25.4	98.1	ND	98.1
LD-SU08N	0 to 12	20.4	65.7	ND	65.7
LD-SU08N	12 to 24	19.4	71.4	ND	71.4
LD-SU08S	0 to 12	ND	ND	4.4	4.4
LD-SU08S	12 to 24	14.9	59.4	ND	59.4
LD-SU09	0 to 12	ND	ND	7.9	7.9
LD-SU09	12 to 24	ND	ND	8.1	8.1
LD-SU10	0 to 12	15.4	63.9	6.2	70.2
LD-SU10	12 to 24	29.7	123.9	ND	123.9
LD-SU14	0 to 12	ND	ND	10.9	10.9
LD-SU14	12 to 24	ND	ND	5.4	5.4
LD-SU16	0 to 12	ND	ND	8.7	8.7
LD-SU16	12 to 24	ND	ND	ND	0.0
LD-SU17	0 to 12	ND	ND	4.2	4.2
LD-SU17	12 to 24	ND	ND	ND	0.0

Notes:

lbs/ac: pounds per acre

N: nitrogen

ND: not detected

NH4: ammonium

NO3: nitrate

ppm: parts per million

Table C2-6

Fertility Report Calculation Summary – Liberty/H&S Bosma Dairies

Field	Date	Previous Crop	Planned Crop	Projected Crop N Use	Residual Nitrates	Residual Ammonium (3-foot)	Mineralization (Past Manure)	Mineralization (OM)	N Used to Consume (Released from) Past Crop Residue	N That May Not Be Accessible	Calculated N Need
LD-SU02	6/11/2019	Triticale	Silage Corn	257	-52	-11	-10	-56	25	15	168
LD-SU03	5/14/2019	Alfalfa	Alfalfa	357	-49	-4	-10	-50	0	15	259
LD-SU04	5/17/2019	Alfalfa	Alfalfa	357	-79	-25	-10	-44	0	15	214
LD-SU05	6/7/2019	Triticale	Silage Corn	257	-201	-7	-10	-50	25	75	89
LD-SU06	5/16/2019	Alfalfa	Silage Corn	266	-70	-13	-5	-36	-60	15	97
LD-SU07	5/16/2019	Triticale	Silage Corn	266	-131	-11	-5	-34	25	45	155
LD-SU08 N	5/17/2019	Alfalfa	Silage Corn	294	-137	-4	-10	-60	-60	40	63
LD-SU08 S	6/7/2019	Triticale	Silage Corn	257	-94	-6	-10	-42	25	15	145
LD-SU09	5/17/2019	Triticale	Silage Corn	276	-34	-16	-5	-38	20	10	213
LD-SU10	5/23/2019	Triticale	Silage Corn	261	-190	-8	-10	-58	25	65	85
LD-SU14	5/17/2019	Triticale	Silage Corn	257	-72	-16	-5	-42	25	15	162
LD-SU16	5/14/2019	Alfalfa	Alfalfa	357	-49	-11	-10	-52	0	15	250
LD-SU17	5/20/2019	Triticale	Silage Corn	230	-21	-6	-10	-36	20	15	192

Notes:

All units are in pounds per acre.

N: nitrogen

OM: organic matter